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CHEMICAL PROCESS/PRODUCTS RESEARCH

Alumina Evaluation

The Alcoa evaluation of Alpart, Reynolds and Kwinana aluminas generally confirms the Columbia Falls evaluations. This indicates an unacceptably high attrition index of approximately 40 percent for the Alpart samples. With the exception of attrition index, our own results are also in agreement. Our attrition index apparatus has been rebuilt according to the original Forsythe-Hertwig paper but we can only achieve gas flow rates about 1/3 those specified. We are still trying to sort out this anomaly.

Bauxite Evaluation

A report, "Bauxite Evaluation" by D. M. Blake outlining our newly established bauxite evaluation procedures was issued. We are currently crosschecking results with the Alpart lab.

Alumina Chemicals

A technical/market analysis for low-soda alumina chemicals was initiated. We are examining the feasibility of a pilot facility in Tucson to prepare high-purity, low-soda alumina from alumina trihydrate via an ACH intermediate for product qualification and eventual production. Preliminary estimates indicate we could produce this material for 20-25¢/lb. Its current market value is \$10-\$12/lb. This study should be complete by year end.

USBM Alumina Steering Committee Meeting

Dan Blake attended this meeting. USBM work on treating the iron chloride waste stream with calcined clay has been completed. This process provides a viable method of recovering the chloride value of the iron stream and converting the iron to an inert material for disposal. Additionally, work on the HCl stripper portion of the bleed stream treatment is very promising. These were two areas we had identified as requiring further development work in our AD-120 process, which has now been largely covered off by USBM.

AD-120 Process

A. Feedstocks Preparation

A method for economically converting Bayer filter cake alumina trihydrate to ACH has been developed. Conversion efficiencies of 100% were attained within 1 hour at 90°C. This material was subsequently partially calcined to PCACH and chlorinated at 650°C. Properties and chlorination rates comparable to clay-derived PCACH were obtained. We therefore, have a process which can also utilize Bayer filter cake as a feedstock.

As a spin-off, full calcination of the ACH product from this process results in a high-purity, low-soda alumina. We have started a program to fully characterize this material and compare it to high-purity, low-soda Bayer-derived alumina.

Eight pounds of partially calcined petroleum coke and thirty-nine pounds of PCACH were produced and forwarded to Alcoa labs for long-term chlorination tests in their pressurized lab reactor. Although we do not have a complete evaluation from Alcoa, initial indications are that:

1. our feedstocks are very active and give a very high mass-transfer coefficient,
2. very low quantities of CO and phosgene in the off-gas confirm the low carbon consumption (approximately 0.40 lb/lb Al),
3. no additional catalyst is required,
4. particle size should be increased to permit an increased fluidizing velocity, and
5. the reaction mechanism is not understood but is different than the alumina system.

PCB results are not yet available.

B. Economic Evaluation

Cost estimates were updated to include mining costs of clay and bauxite. Process flow sheets have been completed and development of the METSIM process model is well underway as a first step for updated, non-factored capital and operating cost estimates.

AD-105 Ammonoalunite Process

The process evaluation group has completed a conceptual capital and operating cost estimate for this process. Estimated capital requirements are about equal to Bayer, with operating costs being slightly more expensive. As a result, this process does not provide a large incentive for alumina production. It may offer some possibilities for other intermediate chemicals such as Al_2S_3 .

but given this information and competing priorities, we will complete the reports on this work and put the project on hold.

REDUCTION RESEARCH

AD-119 Modified Electrolytes

The apparatus for determination of liquidus temperature, conductivity and metal solubility of electrolytes is now operative. Initial base-line data is in good agreement with published material.

Magnesium Processing

Magnesium chloride hexahydrate was generated by reacting $\text{Mg}(\text{OH})_2$ with concentrated HCl and sparging with HCl gas as in the technique for ACH production. A conversion of 99.9+ percent was achieved in 3 hours at 60 to 70°C with a 5:1 HCl: $\text{Mg}(\text{OH})_2$ ratio. A conversion of 99.9 percent was reported under the same conditions in 1½ hours. Final HCl concentrations were 23.8 percent and 25.1 percent respectively. It was also discovered that $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$ can be successfully precipitated from an aqueous saturated solution by sparging with HCl gas similarly to the gas sparging to produce ACH.

Carbon

Our CO_2 and airburn apparatus is now functional. The cell for anode consumption testing has not yet arrived, but this equipment should be operational in order to complete the Ashland pitch evaluation by year end. An interim report of test results (excluding oxidation resistance and consumption figures) will be issued shortly. As anticipated, the A-240 pitched composite has inferior properties to coal-tar pitch composites, but the differential is not as great as determined by Columbia Falls.

Modelling of coke packing characteristics to minimize the required number of experiments for the Sebree Anode Optimization Study-Phase I is progressing. Correlation of packing data for binary mixtures is nearing completion.

DEVELOPMENT AND TECHNICAL SERVICES

Aluminum Association Potlining Recovery Study

A letter was written to the Aluminum Association offering our general support for their funding development of the Martin Marietta pyrosulfolysis process. A list of reservations concerning the process was also included in the letter.

Cell Temperature Sensor

A 200-hour corrosion test of four candidate materials- Si_3N_4 , AlN , Si_2ON_2 and vitreous carbon was initiated. Testing stopped after approximately 80 hours because of failure of the furnace. Problems in testing occurred because of the high vapor pressure of the melt causing condensation of fluorides on the furnace walls and dropping the bath level in the crucible. Results of the

shortened test indicate a severe attack on the Si_2ON_2 sample with erosion at the bath line. None of the other samples showed any erosion.

A new, semi-enclosed crucible is being planned which will allow the easy addition of make-up bath to the crucible for further testing.

IITRI's proposal on surface treating Si_3N_4 with a laser is expected by the end of the year.

Four "delta T" thermocouple devices as per Alcoa's patent arrived for testing. One device is being sent to Columbia Falls in conjunction with testing planned by Gordon Saurey with the Showa Denko heat flow meter. Plans are to conduct a week long test with continuous monitoring of a heat sensor placed on the centerline of the sidewall, 9" below the deckplate. Hopefully, the test will determine if there is a useful correlation between the heat flow and the ledge thickness and if the Alcoa probe can produce similar results.

Columbia Falls Cell Magnetics

During the week of November 1-5, Paul Russell and Linda Long collected heat flux data on the magnetically compensated pot. The 99-point measurements will be used by ASV to perform a heat balance for the cell.

Magnetic field measurements of the cell will be taken as soon as the probe has been repaired. Six point measurements will be taken instead of the sweeps taken in the past.

The cell is producing well, but is noisy with voltage swings of 100 to 200mv. The second cell is planned for conversion by the end of the year. It will be located in either line 4 or 5.

Columbia Falls - Lithium Fluoride

The current 5-pot test is being moved from line 2 to line 5 and expanded to 10 pots. Bath is being transferred from line 2 to 5. Project leader Mike Schneller has set the bath targets for the test at an equivalent bath ratio of 1.35, 4.5% CaF_2 , and 2.5% LiF . Plans are to increase the bath ratio as lithium is introduced to the cells on a scheduled basis.

Sebree Large Anode Test

Samples of regular and large anodes have been received and are currently being measured for electrical resistivity. Also, bath samples are being analyzed in Tucson to determine the background levels of LiF and MgF_2 in the bath.

The 21-pot test continues with an occasional problem in setting an anode because of a frozen bath build up on the adjacent anode. The 24-day cycle has been implemented and butt returns of 24 to 25 percent have been obtained.

Columbia Falls Point Feeders

Currently, 5 pots have point feeders installed. The latest bin design has reduced ore bridging problems that occurred with the first design, but it is expected the problems will be encountered when fine ore is used as in the previous design (similar problems occurred at Sebree with the point feeders when Kwinana ore was used).

The cells continue to perform well with slight improvements seen in current efficiency and anode effect frequency. Room 9 is expected to be completely converted to point feeders by May of 1983.



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